Arsenic Treatment

Presented by

Larry Bustard

Sandia National Laboratories
September 27, 2002

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

Sandia National Laboratories

Arsenic in Drinking Water

Regulatory Background

- World Health Organization recommended a 10 ppb arsenic standard in 1993.
- European Union has compliance date of December 2003.
- US has compliance date of January 23, 2006.
- Some US small systems may get time extensions for compliance.

- **US Impact**
  - 3,341 small systems
  - 104 large systems

US Small Systems

- Serves at least 25 residents
- Serves less than 10,000 residents

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

Sandia National Laboratories

Arsenic Occurrence in New Mexico

- 114 public systems with arsenic levels greater than 10 µ/L (10 parts per billion)
- 80 of these serve less than 1,000 people
- Does not include pueblos and reservations
- Some larger communities impacted at 10 parts per billion

- Albuquerque
- Bernalillo
- Rio Rancho
- Artesia
- Carlsbad
- Columbus
- Hobbs
- Los Lunas
- Lovington
- Ruidoso
- Socorro

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

Sandia National Laboratories

Historical/Ongoing Experiences (Examples)

- San Ysidro, New Mexico (~ 240 residents)
  - Source water exceeds 50 ppb standard.
  - Implemented point-of-use, reverse osmosis treatment.
  - Desires alternative treatment technology because of regulatory compliance concerns.
- Fallon, Nevada (~ 11,000 residents)
  - 100 ppb arsenic.
  - Chlorinates water, no other treatment.
  - Will spend $13M for enhanced coagulation/pressure filter media facility and distribution system
- Severn Trent, a large international water company, is utilizing granular ferric media in its central England water systems.
- Commercial arsenic treatment has been implemented in health centers, schools, bottled water plants, and a few communities.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

Sandia National Laboratories

Historical/Ongoing Experiences (Examples)

- The American Water Works Association Research Foundation (AwwaRF) has/is sponsoring approximately 20 projects related to arsenic treatment, including:
  - Piloting arsenic treatment technologies at various US locations.
  - Investigating the impact of water chemistry on treatment performance.
  - Examining issues associated with point-of-use technologies.
  - Understand residuals management/disposal.

- The University of New Mexico is piloting granular media at several New Mexico Indian tribe locations.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

Sandia National Laboratories

Current Technical Status

- Granular ferric media work for some, but not all, systems.
  - High silica levels, high water pH, and other water chemistry issues are problematic.
  - Water chemistry decision tool not available.

- Other technologies, such as enhanced coagulation/filtration processes, likely to be implemented, particularly by larger water systems.

Local Water chemistry is very important

to technology success and cost

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

Sandia National Laboratories

Other Issues

- Arsenic treatment costs may be large, particularly for some small systems.
- Many groundwater systems lack treatment infrastructure and/or capabilities (technical, managerial, financial).
- Arsenic treatment experience is not available to support decision making.
- "Small systems are being asked – in some cases for the first time – to grapple with a whole new set of public health challenges." (Report to Congress: Small Systems Arsenic Implementation Issues, EPA 815-R-02-003, March 2002)

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

Sandia National Laboratories

What is Needed

- Better definition of water chemistry impacts on technology performance.
- New arsenic treatments where water chemistry precludes use of ferric media.
- New or improved arsenic treatments that lower costs.
- Additional small system arsenic treatment experience to facilitate decision-making.
- Financial and technical support to small systems.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

Sandia National Laboratories

US EPA Efforts

- Development of innovative technologies by small businesses.
- Small system demonstration of commercial technologies
  - 17 small systems selected for possible demonstrations.
  - Requesting vendor proposals for full-scale, one-year demonstrations.
  - Expect to fund 10 – 12 proposals.
  - Expect to start demonstrations in about a year.
- Technical assistance and training.
- Enhanced internal EPA research (water chemistry impacts, management of arsenic treatment wastes, impacts on distribution system).

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

Sandia National Laboratories

Sandia National Laboratories Efforts

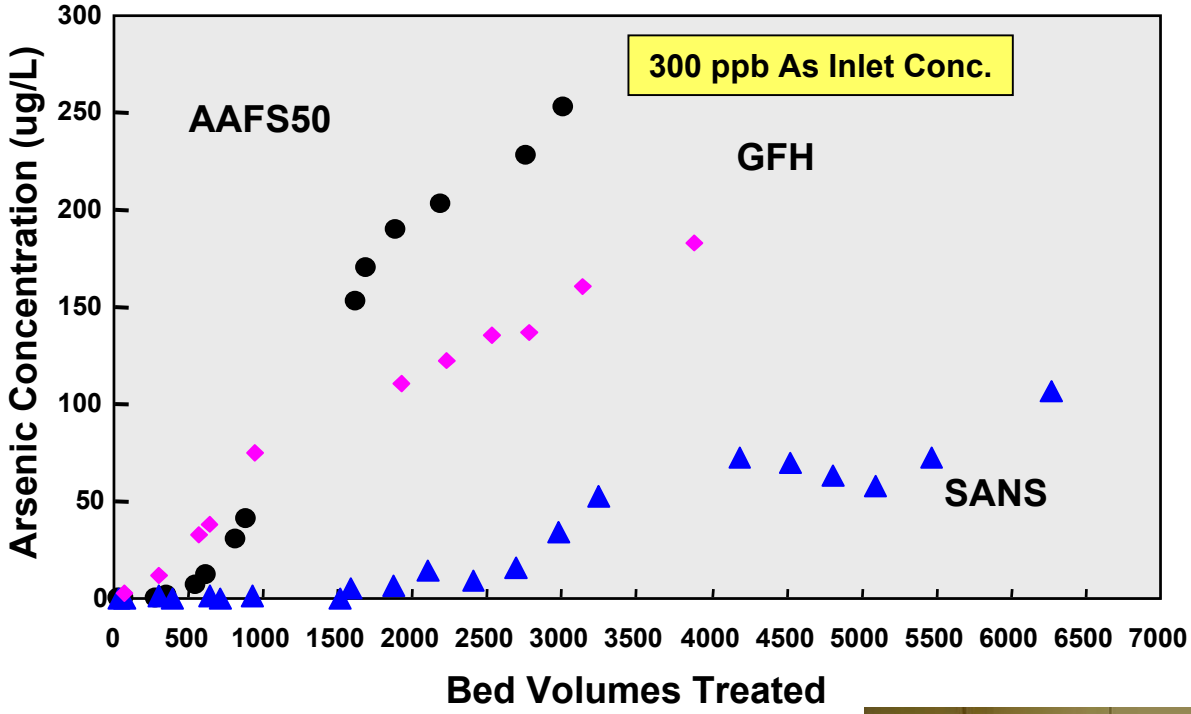
- Invent, field test, and commercialize innovative materials for filter media or enhanced coagulation processes.
  - Materials/processes that work in difficult water chemistries.
  - Materials/processes that have reduced costs.
- Planning a program with AwwaRF and WERC that:
  - Utilizes an expert workshop to define key technology gaps.
  - Includes a broad-based innovative technology development effort.
  - Does field testing of new or improved technologies (including pre-commercial).
  - Provides economic information and technology assistance to US water systems with emphasis on small and Indian tribe needs.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

Sandia National Laboratories

Sandia National Laboratories: SANS™ Media

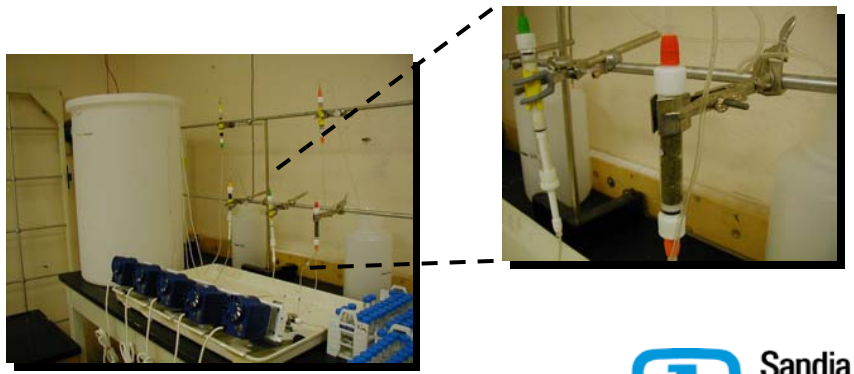
Laboratory Column Tests



Water Influent

Anion	SNL H_2O
HCO_3^-	131 ppm
$H_3SiO_4^-$	67 ppm
Cl^-	31 ppm
SO_4^{-2}	30 ppm
F^-	0.9 ppm
NO_3^-	0.3 ppm
As (V)	300 ppb
pH	8
EBCT	5 min.

SANS Materials Pass Toxicity Characteristic Leaching Procedure (TCLP)



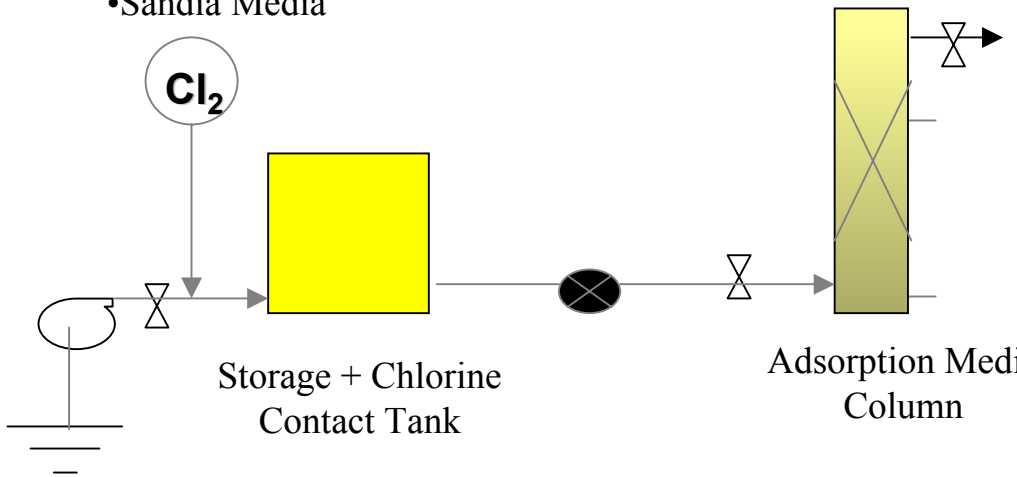
Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

Sandia National Laboratories

KIRTLAND AFB FIELD TRIAL OF DIFFERENT ARSENIC ADSORPTION MEDIA

Media Under Evaluation

- Activated alumina (ALCAN-AASF50)
- Granular Ferric Oxyhydroxide (GFH)
- Sandia Media



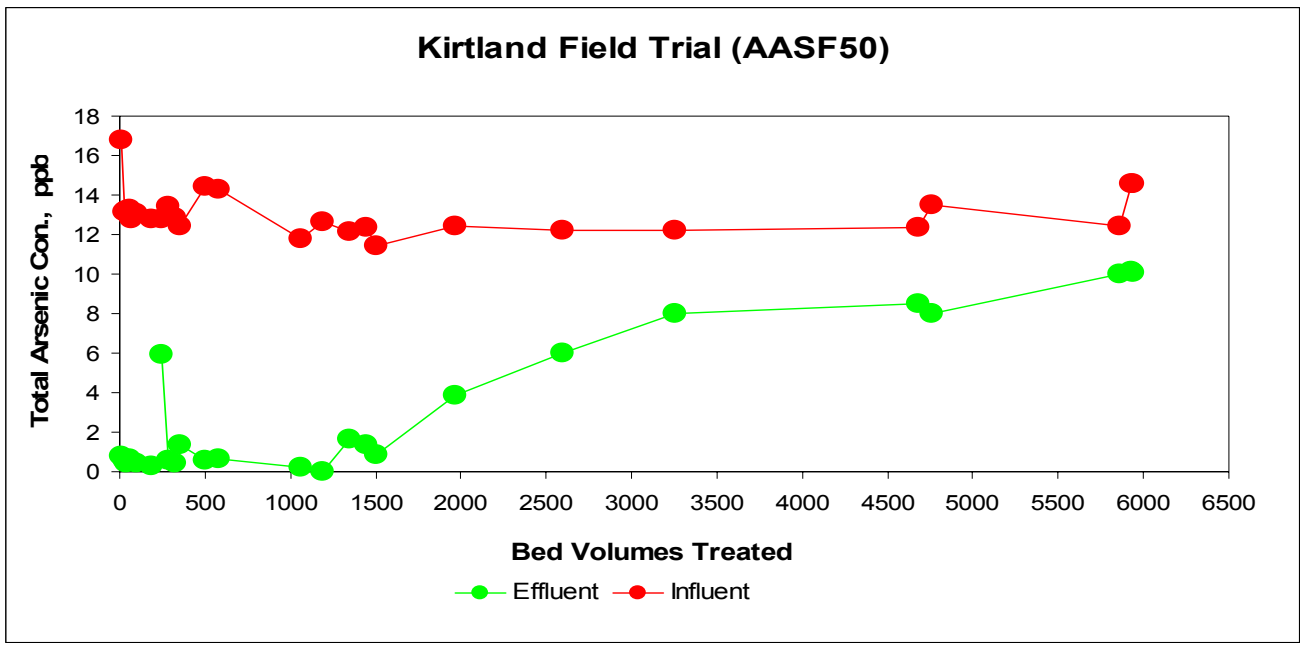
Process Operations Parameters

- Empty Bed Contact Time (media volume/flow rate) = 5 min
- Flow = 1.0 L/min (1440 L/day)
- Media volume = 5.0 L

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

Sandia National Laboratories

RESULTS TO DATE - ACTIVATED ALUMINA



Influent Water Quality

As(v) = 12-15 ppb

pH = 7.5-8.3

HCO_3^- = 70-100 mg/L

SO_4^{2-} = 25-40 mg/L

$H_3SiO_4^-$ = 50-80 mg/L

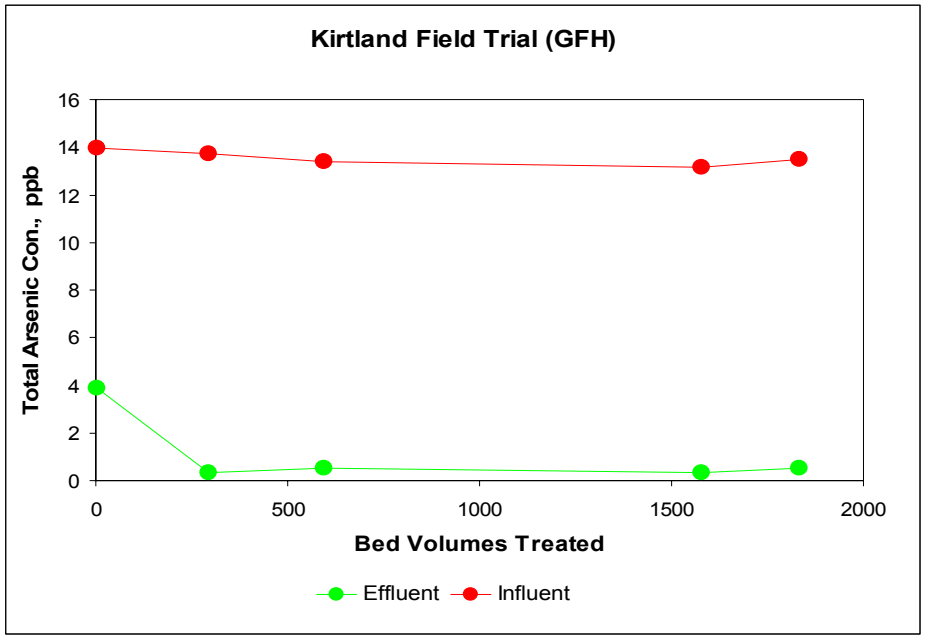
Column breakthrough(approaching 10 ppb As(v)) roughly at 5500 bed volumes of water treated (29,000 Liters of water)

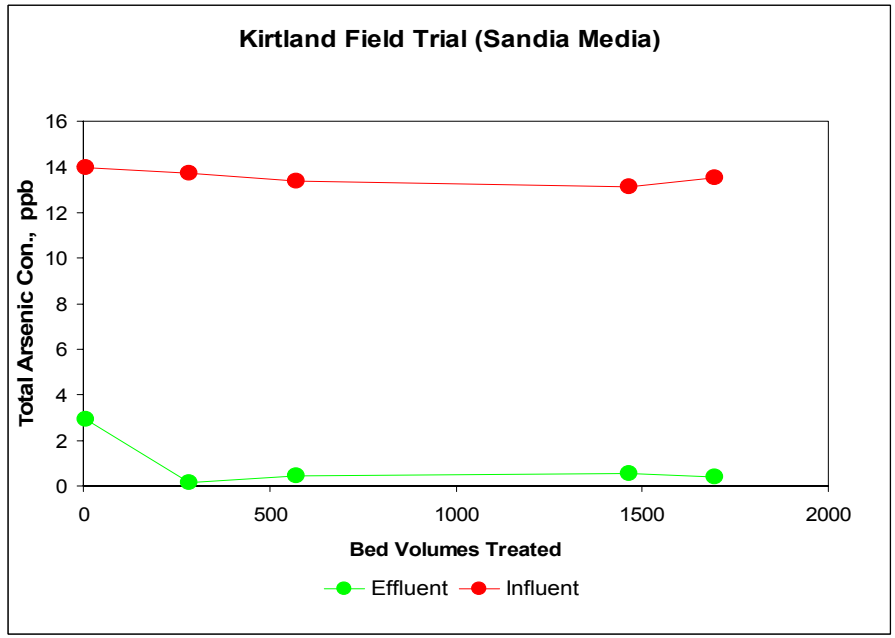
Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

Sandia National Laboratories

RESULTS TO DATE

Granular Ferric Oxyhydroxide (GFH) and Sandia SANS™ Media





At 1,800 bed volumes of operation (9,000 Liters of water) both GFH and Sandia Media is removing arsenic at greater than 96% efficiency

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

Sandia National Laboratories

Mexico/US Collaboration Possibilities

- Participation in expert workshop to define key technology gaps.
- Enhanced cross-border communications (El Paso/Juarez).
- Collaborative field testing of new technologies.
- Information exchange on technology effectiveness.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

Sandia National Laboratories